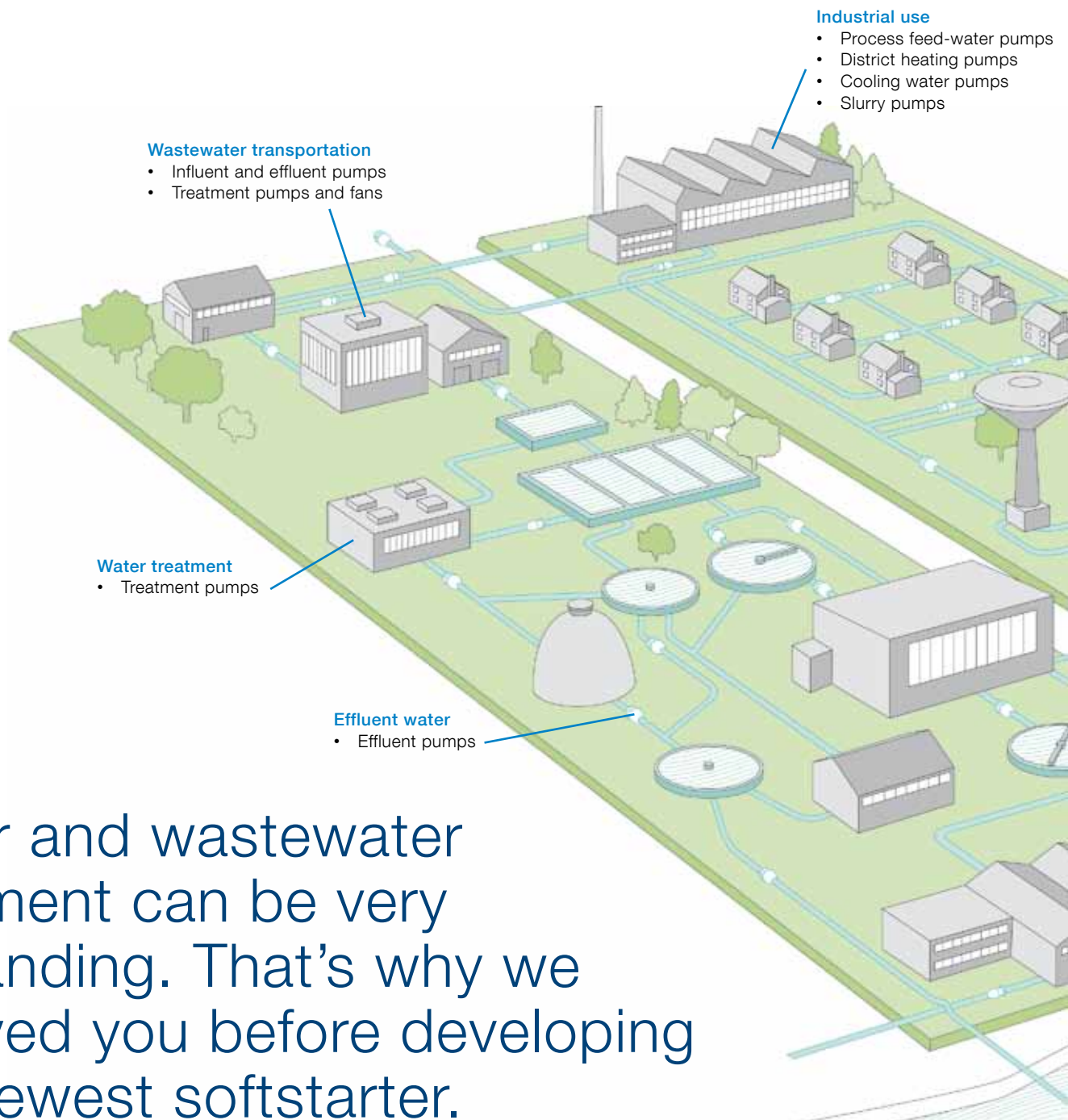


Brochure

# Softstarters Solutions for Water and Wastewater Management



# Water and wastewater treatment can be very demanding. That's why we involved you before developing our newest softstarter.

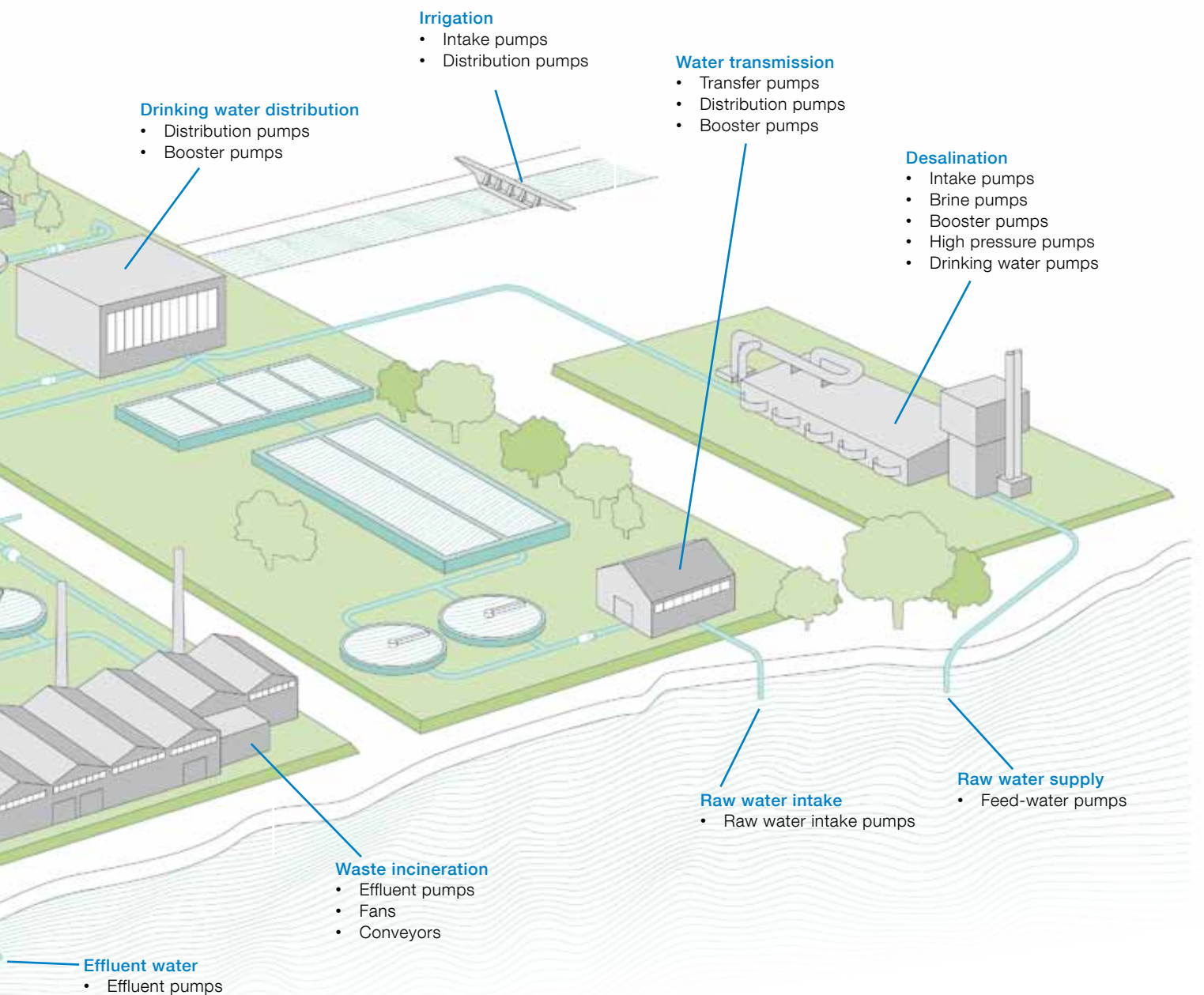
## Water can be found everywhere

Water is the world's most important resource and water facilities can be found all over the world. Freshwater systems bring water from the source to cities, offices, residential areas, factories, and up in high-rise buildings.

Wastewater systems bring the sewage water in the opposite direction to purification plants, where additional pumping systems transport the water between different parts of the purification plants. This is done until the water is clean enough to be transported back into lakes or into the ocean. As well, in many parts of the world, both freshwater and wastewater systems are being built to be able to support the rising living standard for a growing population.

In fact, the global demand for water is expected to increase by more than 50% over the next 30 years. In other parts of the world there is instead a big demand for new and upgraded water plants since the existing plants are old and outdated.

Only a few percent of all water in the world is freshwater, and to support the growing population with water, desalination plants are being constructed in many parts of the world. In addition, pumps are used to circulate water for district heating or cooling, irrigation, drain water pumping and more.



Regardless of the application, pumping water can be a demanding business involving problems such as water hammering when stopping the pumps, voltage fluctuations in the network when starting, and problems with jammed or clogged pumps. All of these problems need to be solved in order to keep the water facilities operational and in order to secure a reliable water management.

#### Listening to customers is rewarding

Due to the importance of water as a resource, ABB has focused on developing efficient solutions for water and wastewater management. Efforts are put into understanding this specific segment as it is today and how it will evolve.

This applies to most of ABB's products, not the least softstarters. To reach our ambition of having a complete and broad softstarter portfolio for water and wastewater solutions, many customers were interviewed world wide, giving us an even better understanding of their business and true needs. This led us to develop the new and efficient PSE softstarter, completing the ABB softstarter portfolio for the water and wastewater business.



# Different pump systems require different solutions

As previously mentioned, pump systems can be found everywhere. Pumps are used for freshwater and wastewater in order to provide communities with those services as most of us take for granted. Pumping systems are also used in the industry such as, in chemical processes. Circulating water is used in warm countries for cooling and in colder countries for heating.

These systems differ in many ways, but there are two main types of pumping systems; pressurized systems and non-pressurized systems.

## Pressurized systems

Pressurized systems are designed to have a constant pressure, which needs to be maintained even though the water usage may vary. Traditionally this was solved by using water towers, but a more modern solution is to regulate the speed of at least one feeder pump in order to keep the pressure up in the system. Another example of a pressurized system is where booster pumps are used to increase the pressure in water pipes in order to move water for longer distances.

## Non-pressurized systems

Non-pressurized systems are mainly used to move water, either horizontally or to an elevated location. In for instance wastewater systems, the water is flowing by the force of gravity and collected in different water reservoirs. Moving the water between different reservoirs or to pump the water back into the lake or ocean is typically done in a non-pressurized system.



**Pressurized and non-pressurized pump systems need different designs and different solutions in order to provide a reliable and efficient operation.**

**Using softstarters in pressurized systems**

In most pump systems, several pumps are used in parallel to provide a more flexible solution and to secure high availability. To keep the pressure constant in a pressurized system, for example, in a fresh water feeding network, it is enough to regulate the speed of one of the pumps, using a variable speed drive. If more than one pump is needed, the additional pumps can be started and operated at a constant speed. The speed regulated pump is then still used to secure the constant pressure, but now with the help of the additional pumps.

The constant speed motors in this kind of system, are required to be started and stopped as the need for pumping increases and decreases. Depending on the starting method, these starts and stops can cause problems with water hammering, pressure surges and voltage fluctuation. However, with the development of advanced softstarters with features like torque control, these problems can be reduced or even eliminated, so today this is the preferred solution.

Using softstarters in combination with a variable speed drive, will provide a more compact and cost efficient solution than using only drives.

**Using softstarters in non-pressurized systems**

An example of a non-pressurized system is level control, meaning that the water level in a reservoir is kept on a more or less constant level. As water comes in, it is pumped out.

In most level control applications there is no need to keep an exact water level. Instead, most important is to keep the water level within the specified range. When the water reaches the maximum level, the motor is started and water is pumped until the water level reaches the minimum mark.

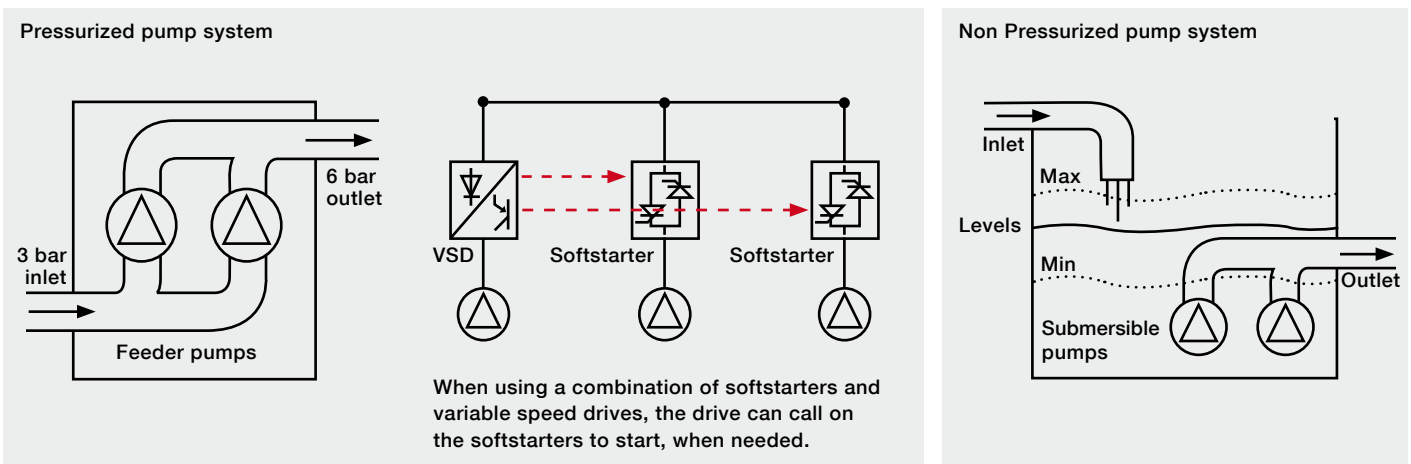
Non-pressurized systems like these are the perfect application for softstarters since there is no need for speed regulation and since a soft start and stop is needed to avoid water hammering.

Another common problem in wastewater systems is clogging, which is caused by having too slow speed of the water. This problem will be avoided by using constant speed motors, controlled by softstarters.

**Using softstarters as back-up for variable speed drives**

In critical systems where the pumps always need to be operational, a cost efficient solution can be to use softstarters as backup for variable speed drives. In case there would be problems with the drive, a softstarter is used to start the motor, still ensuring a soft start and stop.

**Using softstarters in combination with a variable speed drive, will provide a more compact and cost efficient solution than using only drives.**



# Prevent water hammering with torque control



The ABB torque control function is developed together with pump manufacturers to ensure the best possible pump stop, eliminating problems with water hammering and pressure surges.

## The problem with water hammering

One of the most challenging problems in pumping applications comes when stopping the pump. The water pressure in combination with the high friction in a pumping system and the low moment of inertia of a pump has the effect that if direct stop is used, the motor will stop very fast.

This will result in the water column returning, crashing into the closing valve, and it might create additional pressure waves in the pipe system. This whole phenomenon is called water hammering and it can be heard as a very loud banging sound with vibrations in the whole system.

The forces of a pipe filled with water are enormous. In a single stop of the motor, this will only cause an unpleasant sound, but water hammering at every stop, day in and day out, will quickly wear out the valves, gaskets and pipe connections. This will increase the need for maintenance, service and repair or even worse, cause unplanned downtime.

The solution to all of this is to make a gradual slow down of the water flow in the system. However, since many pipe systems are complex it might not be enough just to do a normal soft stop using a voltage ramp. There is a need for a regulation of the motor torque in order to slow down the water flow in just the right way. This is why torque control was developed.

## Torque control – optimized for stopping pumps

Traditionally a softstarter performs a soft stop by ramping down the voltage linearly from the full voltage to the end voltage. However, when decreasing the voltage, the motor is self compensating, using more current from the network to be able to maintain its speed. Then when the voltage has dropped enough, the motor will become too weak and the speed will decrease way too fast. A stop like this is far better than a direct stop, but in many cases it is not good enough, and as a result there may still be water hammering.

Torque control uses a very advanced algorithm, and controls the motor torque both during start and stop. This function is based on a closed loop regulation where both the voltage and the current are measured. With this information, the torque of the motor can continuously be calculated with a high accuracy. The voltage applied to the motor is then adjusted so that the resulting motor torque is kept exactly on the required level.

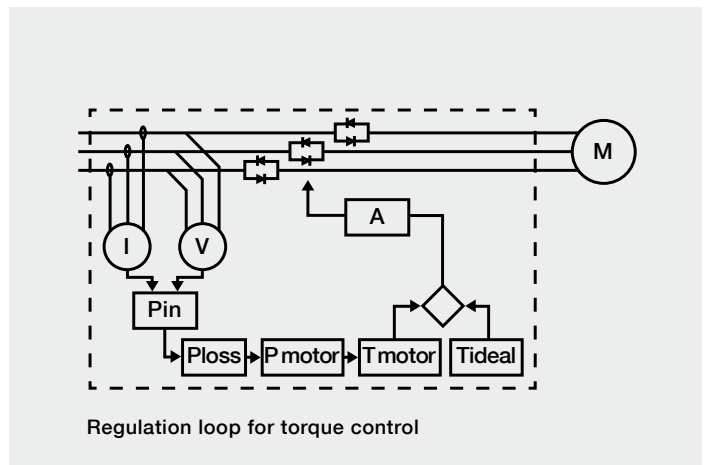
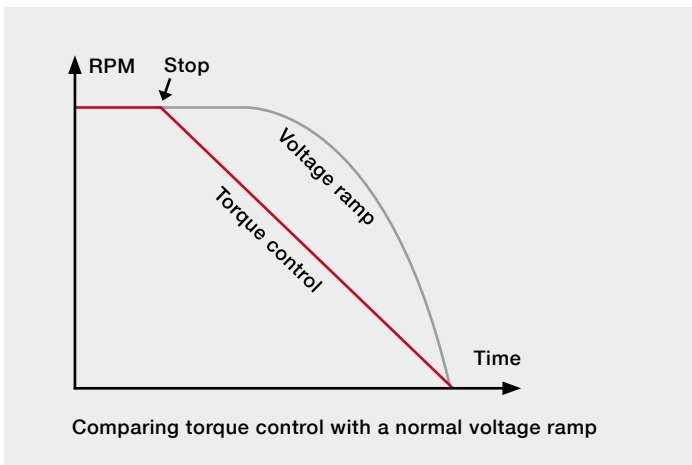
Being able to have good control of the torque of the motor is crucial to be able to prevent water hammering when stopping. However, this is not enough. What is also needed is a deep understanding of how the motor and the pump will perform and in which way the torque needs to be decreased in order to prevent water hammering. ABB has for a long time worked closely together with pump manufacturers in order to gain this knowledge. More than a thousand different tests and simulations with different combinations of pumps and motors have resulted in the perfect way of stopping pumps.

Independently of how sophisticated a function is, it should still be easy to setup. Using the torque control function in the PSE and PST(B) softstarters from ABB, there is no need for speed feedback from the motor and there is definitely no need to input any additional motor data. The only required setting is to select if torque control should be activated or not. Using the predefined application setting in the PST(B) softstarter, torque control will be used automatically when you select your pump application.





Water hammering is one of the most serious problems for pumping applications and need to be solved in order to ensure a reliable operation.





### More valuable functionality

Even though water hammering is one of the biggest challenges in water systems, unfortunately it is not the only one. In wastewater systems it is quite common for objects to enter the pump system. These objects might block the pump wheel. ABB soft-starters equipped with locked rotor protection can detect this and stop the motor in order to prevent both the pump and the motor from being damaged.

Objects in the pump system might also prevent the pump from starting. To overcome this problem, pumps are usually designed to cut through these objects, but a certain amount of torque is needed. A softstarter equipped with kick start can provide the required torque, while still ensuring a soft start.

Another potential problem is if the pump continues to rotate even though there is no more water available – the pump is running dry. During normal operation, the water provides lubrication and reduces the friction in the pump. Without the water, the mechanical wear on the pump will be higher and some pumps might even be damaged. This can be avoided if using a softstarter equipped with underload protection, since it will detect the reduced current caused by the low loaded motor and stop the pump.



# PSE with torque control replaces bulky pressure tanks

Wastewater station, Irsta, Sweden  
Mälarenergi



## Securing a reliable wastewater treatment

Irsta is a typical Swedish community, located approximately 100 km west of Stockholm and has about 2,500 inhabitants. The wastewater from the whole community flows by the force of gravity to one single pumping station where the water is collected in a reservoir. As soon as the water level reaches a maximum mark, one of the two alternating pumps are started. The water is then pumped into the municipal wastewater system and eventually ends up at the water treatment plant.

Mälarenergi is responsible for this and many other pumping stations across this part of Sweden. When first constructing these pumping stations, motors were started Direct on line. However, this created big problems with water hammering when stopping. The back valve in some systems even had to be changed since it was damaged as a result of the water hammering.

To reduce the problem, big pressure tanks were installed, but now most of the pumping stations are being rebuilt and softstarters are used to control the motors. Softstarters will further reduce the water hammering and also provide a much more compact solution, without the need for the pressure tanks. This saves both space and money.

“By using a softstarter, there is no need for pressure tanks.”

This pumping station has been equipped with one of the first PSE softstarters installed (PSE30), to control the motors. The PSE is a preferred solution since it has torque control and also coated circuit boards to better withstand the sulphuric acid that may sometimes exist in these pumping stations.

# Reducing mechanical wear using ABB softstarters

Drainage pumping, Dongshan, Jiangning, China  
Taizhou Taifeng Pump Industry Co., Ltd.



“After using ABB soft-starters, the frequency of replacing parts has been greatly reduced.”

In the past, star delta starters were used to control the motors in the pump station, but the increased performance demands has led to using PSTB470 softstarters in the 12 new storm drainage pumping stations.

## Increasing the drainage capacity more than tenfold

The old city of Dongshan is the cultural and political center, located in the city of Jiangning. Increased urbanization has led to an insufficient capacity of drainage pumping. Under continuous heavy rainfall and with a capacity of only  $7,5\text{m}^3/\text{s}$ , this has sometimes led to waterlogging.

Recently, 12 new storm drainage pumping stations has been constructed, increasing the drainage capacity to  $100\text{m}^3/\text{s}$ . In all of these new pumping stations, PSTB softstarters are used to start and stop the motors. This will reduce the inrush current while starting, but most importantly, provide a superior stop of the pump. This can even be realized by the reduced noise level. Since the mechanical wear on the whole pump system is greatly reduced, the life length of mechanical parts in the system has been prolonged.

Several of the advanced built-in protections of the softstarter are being used, and with the full text display, possible to set to Chinese, it is very easy for the users to understand on which protection the softstarter has tripped.

# Irrigation in the desert made possible with ABB softstarters

Potato and corn farm  
Wadi El Natron, Egypt



## Pumping up water from 200 meters below the desert

Wadi El Natron is located 100 km northwest of Cairo. This area would normally be a desert, but thanks to heavy irrigation, it is now possible to grow potato and corn. You would never suspect that only a few years back, this area was covered by sand.

The water is pumped up from 200-300 meters underground by big submersible pumps. The pumps are usually only started once a day and are then running for 15-20 hours. The high static head in these systems and the few starts per day makes softstarters a very energy efficient solution. To save even more energy, by-pass contactors have been installed.

Even though the pumps are usually started and stopped only once a day, it is crucial to avoid water hammering in these long vertical pipes. This is the main reason why PST softstarters are used. What is also really appreciated is that it is so easy to install and set-up.

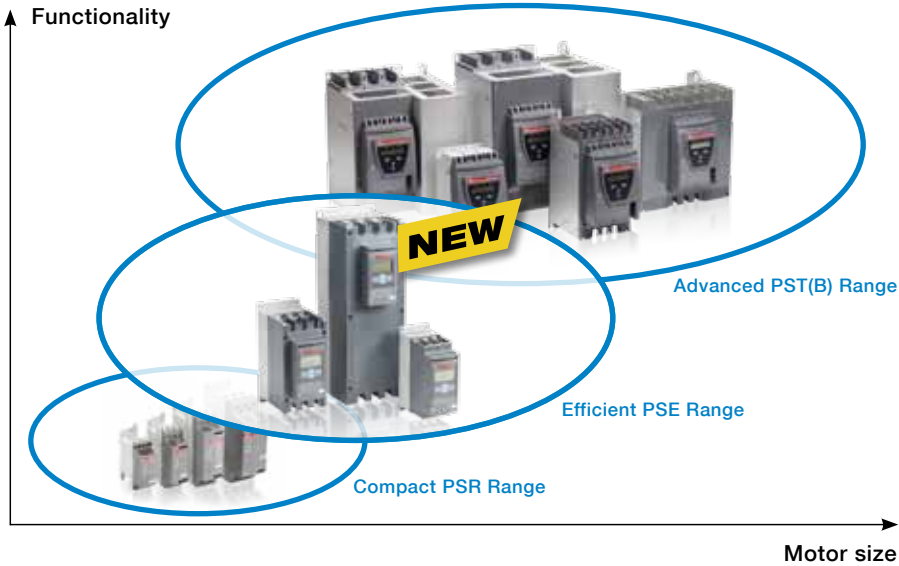
To even further increase the reliability of the systems, many of the protections in the PST softstarters are used. This include locked rotor protection, underload protection, phase imbalance protection, phase reversal protection and motor overload protection.

“ABB Softstarters irrigate the desert, protect the pumps and withstand the tough conditions.”

This site consists of 27 stand alone pumps, each of them controlled by a PST175 softstarter. Each pump has a pumping capacity of 120m<sup>3</sup> per hour.



# The ABB Softstarter portfolio



With the softstarters from ABB, it is always possible to find a good starting solution regardless of the size of the motor and the required functionality. The product portfolio includes the cost efficient compact PSR range, the advanced PST(B) range and the new efficient PSE range completing the family.

## The Compact PSR range

- Where space is limited
- Basic functionality
- Up to 105 A
- In line connection
- Up to 600 V

## The NEW Efficient PSE range

- The most important functionality for pumps
- Torque control
- Up to 370 A
- In line connection
- Up to 600 V

## The Advanced PST(B) range

- Where the most advanced functionality is required
- All protections
- Programmable functionality
- For really heavy duty starts
- Absolute lowest starting current
- Torque control
- Up to 1050 A (1810 A inside delta)
- In Line or Inside delta connection
- Up to 690 V

• Standard    O Opional    – Not available	PSR	PSE	PST(B)
Built-in by-pass <sup>1)</sup> on PSTB	•	•	• <sup>1)</sup>
Inside delta connection	–	–	•
Coated PCBs	–	•	O
Display and keypad	–	•	•
Torque control	–	•	•
Settable current limit function	–	•	•
Electronic motor overload protection	–	•	•
PTC input for motor protection	–	–	•
Phase imbalance protection	–	–	•
Phase reversal protection	–	–	•
Locked rotor protection	–	•	•
Thyristor overtemperature protection	–	•	•
Underload protection	–	•	•
Programmable warning functions	–	–	•
Analog output	–	•	•
FieldBus communication	O	O	•
Event log	–	O	•
External keypad	–	O	O

# Softstarter PSR – the Compact range

## Functional description



### Product description

- Wide rated operational voltage 208 – 600 V
- Rated control supply voltage 24 V DC or 100-240 V AC
- Rated operational current 3 – 105 A
- Wide ambient temperature range, -25 to +60 degrees Celcius
- Built-in by-pass on all sizes, saving energy and reducing installation time
- Potentiometer settings
- Run signal relay on all devices
- TOR signal relay on PSR25...105
- Optional fieldbus communication using Profibus, Modbus, Devicenet or CANopen
- DIN rail mounting on PSR3...45
- Screw mounting on all sizes
- Connection kits for easy connection with ABB manual motor starters
- Sophisticated algorithm eliminating the DC-component and thereby providing excellent starting performance.

The PSR range is the most compact of all the ABB softstarter ranges, thereby making it possible to fit many devices into the same enclosure. The system concept with Manual Motor Starters provides a far more compact starting solution than for instance a star delta starter.

### Flexible mounting

PSR softstarters from 3 to 45 A are possible to mount on a din rail, ensuring quick and easy mounting. Naturally, all sizes can be mounted with standard screws.

### Few settings

The set-up of the PSR is easily done and confirmed using the three clearly marked potentiometers on the front.

### Built-in by-pass for energy saving

The built-in by-pass on all sizes does not only save energy; it will also ensure the most compact ABB softstarter design and reduce the installation time. Thanks to the reduced heat generation, the softstarter can be mounted inside high IP class enclosures.

### Suitable for stopping pumps

Even without using torque control, the PSR range is designed to reduce water hammering and will allow a superior stop compared to the direct stop resulting from a star delta starter or a DOL starter.

### System concept with manual motor starters

All PSR softstarter sizes can easily be connected to the corresponding manual motor starters from ABB, using the special designed connection kits. This will both make the mounting and the connection easier and will provide a very compact starting solution containing short circuit and thermal protection, isolation function and soft starter – everything that you need.

# Softstarter PSE – the Efficient range

## Functional description



### Product description

- Wide rated operational voltage 208–600 V AC
- Wide rated control supply voltage 100–250 V, 50/60 Hz
- Rated operational current 18 to 370 A
- Wide ambient temperature range, -25 to +60 degrees Celsius
- Coated circuit boards for reliable operation in harsh environments
- Built-in by-pass on all sizes, saving energy and reducing installation time
- User friendly HMI with illuminated language neutral display and four button keypad
- Optional external keypad, IP66
- Torque control for excellent control of pumps
- Current limit, adjustable between 1,5-7xIe
- Motor overload protection with classes 10A, 10, 20 and 30
- Motor underload protection to detect pumps running dry
- Locked rotor protection, detecting jammed pumps
- Kick start to start jammed pumps or conveyor belts
- Analog output showing operational current, 4-20 mA
- Optional fieldbus communication using Profibus, Modbus, Devicenet or CANopen
- Sophisticated algorithm eliminating the DC-component and thereby providing excellent starting performance.

The PSE softstarter range is the world's first compact softstarter with torque control. This makes the PSE range an excellent choice for pumping application where water hammering normally is a big problem. The softstarter is equipped with all the most important features for pumping applications making it a very efficient choice.

### Torque control

The most important function when stopping pumps is torque control. Since the PSE softstarter is optimized for controlling pumps, this feature is a must.

### Built-in by-pass for energy saving

Using by-pass after reaching full voltage will greatly reduce the power loss and thereby save energy. In the PSE softstarter range, the by-pass is built-in on all sizes, which will give the most compact starting solution and reduce the need for wiring during installation.

### Coated circuit boards

All circuit boards in the new PSE softstarter have a protective coating to ensure a reliable operation even in tough environments like wastewater plants, where corrosive gases and acids may exist.

### Motor protection

The PSE softstarter is equipped with built-in electronic overload protection, protecting the motor from overheating. Since no additional overload device is needed, our efficient design saves both space, installation time, and ultimately money.

### Analog output

The analog output terminals can be connected to an analog current meter to show the current during operation and thereby eliminating the need for an additional current transformer. The analog output signal can also be used as an analog input to a PLC.

### Display and keypad

The set-up of the PSE softstarter is done using the four button keypad and the illuminated display, providing a quick and easy set-up. While operating, the display will also provide important status information such as current and voltage.

### External keypad

As an option the PSE softstarter can be equipped with an external keypad for easy set-up and monitoring of the unit without opening the enclosure door. The keypad can also be used to copy parameters between different softstarters.



# Softstarter PST(B) – the Advanced range

## Functional description



### Product description

- Wide rated operational voltage 208 - 690 V AC
- Wide rated control supply voltage 100 – 250 V, 50/60 Hz
- Rated operational current 30 to 1050 A (Up to 1810 A inside delta)
- Both in line and inside delta connection
- Coated circuit boards available, for reliable operation even in harsh environments
- Full text display in 14 languages and 4 button keypad for easy set-up and operation
- Optional external keypad, IP66
- Built-in by-pass contactor on PSTB (from 370 A) for energy saving and easy installation
- Prepared for external by-pass on PST (30-300 A)
- Torque control for excellent control of pumps
- Current limit, adjustable between 1,5 – 7xIe
- Fieldbus communication using Profibus, Modbus, Devicenet or CANopen
- Dual motor overload protection with classes 10A, 10, 20 and 30
- Adaptable motor underload protection to detect pumps running dry
- Adaptable locked rotor protection to detect jammed pumps
- PTC protection to protect the motor from overheating
- Adjustable kick start to start jammed pumps
- Programmable output signal relays
- Programmable pre-warning functions
- Event log with time stamp
- Analog output showing current, voltage, power factor etc. 0-10 V, 0-20 mA, 4-20 mA

The PST(B) softstarter is the most advanced softstarter in the ABB product portfolio and is equipped with almost all imaginable features. This makes the PST(B) ideal for almost every application.

### Torque control

The ABB torque control function is developed together with pump manufacturers to ensure the best possible pump stop, eliminating problems with water hammering and pressure surges.

### By-pass for energy saving

By-passing the softstarter after reaching full voltage, will save energy and reduce the heat generation. The PST softstarters are equipped with extra terminals making the connection of an external by-pass contactor easier and allowing all protections to be active during by-pass. On the PSTB softstarters, an ABB AF-contactor is already built-in, ensuring a compact starting solution with minimal wiring during installation.

### Advanced protections

The PST(B) softstarters are equipped with almost all protections imaginable for protecting the motor, the softstarter and the application. To offer more flexibility, all protections can be tailored to your specific needs.

### Flexible analog output

The analog output terminals can be connected to an analog current meter to show the current during operation and thereby eliminating the need for an additional current transformer. The analog output signal can also be used as an analog input to a PLC.

### Fieldbus communication

Using the ABB FieldBusPlug, all the most common fieldbus protocols are supported. Using the PLC system it is possible to set-up the softstarter, read status information and also to control the softstarter.

### Display and keypad

The PST(B) softstarter is equipped with a full text display showing all information in clear text in your own language. To make it even easier to set-up, there are standard settings for many common applications, such as centrifugal pump. Selecting this will automatically provide all required settings including torque control when stopping.

### External keypad

As an option, the PST(B) softstarter can be equipped with an external keypad for easy set-up and monitoring of the unit without opening the enclosure door. The keypad can also be used to copy parameters between different softstarters.

# Contact us

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